Space Weather Technical Forecast

Issued on Sunday, 09 October 2022 at 01:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares. Active electron Fluence.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Low, with only small C-class flares observed. There are six sunspot regions on the Earth-facing disc. AR3112 Fki/Beta-Gamma-Delta, which has now traversed into the northwest disc, is the largest, and most complex region. Despite this, it has persisted as a stable area with only limited development amongst its intermediate spots, and ongoing gradual decay of its leader. AR3116 Esi/Beta to the north of AR3112 is a smaller and relatively stable region, but was the source of the most recent M-flare, on the 7th. AR3119 Dai/Beta has exhibited some growth in areal extent during the last 24 hours, but remains a relatively simple, and small region. The other regions are smaller and generally decaying. There are currently numerous filaments scattered across the disc, however these have remained attached with no eruptions occurring. No Earth-directed CMEs were visible in available coronagraph imagery.

Solar Wind / Geomagnetic Activity: The solar wind.as measured by DSCOVR at L1 was mainly elevated, likely due to ongoing fast wind influence with speeds between 480 and 550 km/s, and with the density at or below average. The total IMF strength, Bt, remained weak at 4-7nT, with the north-south component Bz variable between +5nT and -6nT, but more frequently negatively (southward) pointed rather than positive (northward). The phi angle was predominately in the positive sector (away from the Sun). Geomagnetic activity was Quite to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, has been at Background levels. High energy electron flux (greater than 2MeV) has been at Moderate to High levels, peaking at 2900pfu at 07/1525 UTC. The associated 24-hour fluence has been above the Active (1e8 integrated pfu) threshold throughout. The 09/0000 UTC observation was 1.28e8 integrated pfu

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low with a chance of rising to Moderate with any M-flares. There is an ongoing slight chance of rising to High due to the potential of AR3112 producing an isolated X-flare.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs in the forecast, however an observed CME due to a filament eruption around 07/0730UTC may pass close to the Earth either late day 3 or early day 4 (11th or 12th), giving some very slight peripheral influences. Otherwise, ongoing fast winds, perhaps transitioning into those from CH29/+ on day 1 (9th) are likely to gradually ease through the period, approaching or falling to background by day 4 (12th). Geomagnetic activity is forecast to be Quiet to Unsettled. Active intervals are possible day 1 and perhaps day 2 (9th and 10th), with a slight chance of G1-Minor Storms day 1 (9th).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is

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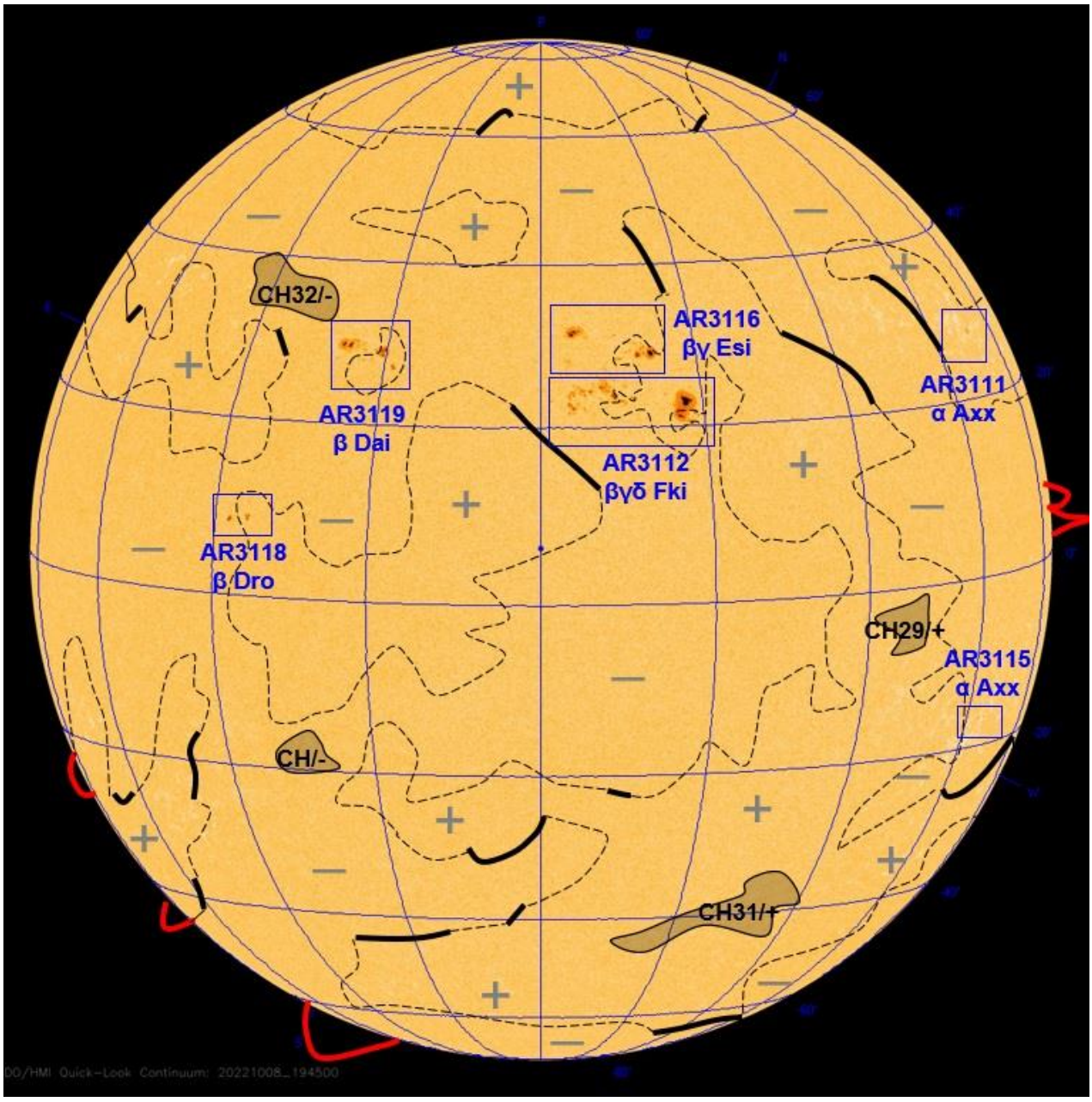
expected to be near Background for much of the period, but with a slight chance of rising in response to any large flares, primarily from AR3112 or AR3116 in the northwest disc. This giving a slight chance of exceeding the S1 level. The high energy electron flux (greater than 2 MeV) is likely to persist at mainly Moderate to High levels, perhaps briefly suppressed day 1 (9th) from any further fast wind enhancement that occurs from CH29. The associated electron fluence is forecast to persist at Active levels, but with confidence declining later in the period.

Figure 1. Solar Analysis Valid 08/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

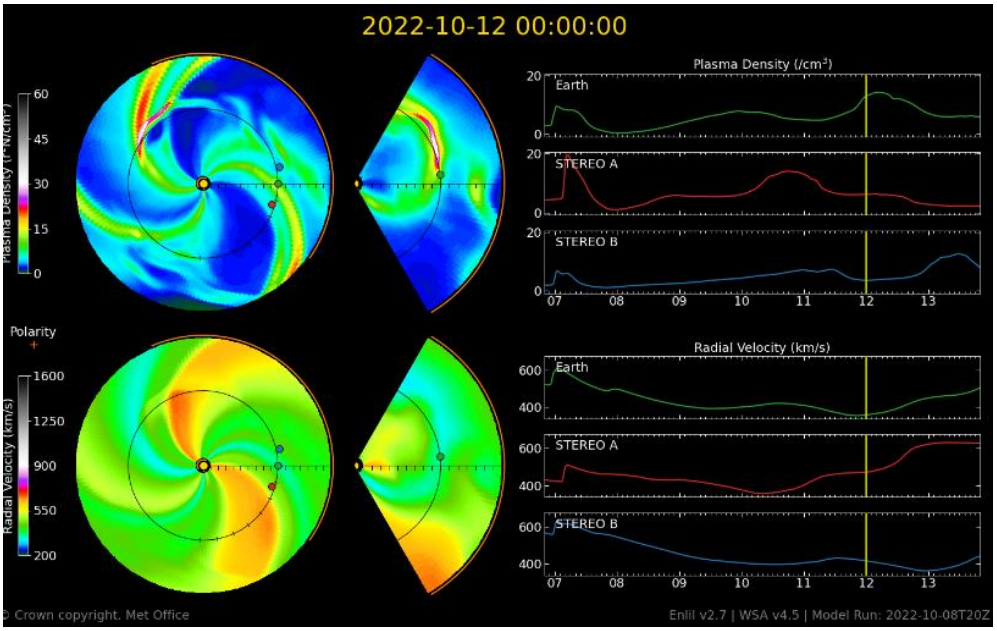
There are no CMEs which are forecast to be Earth-directed. However there is a CME expected to give a close miss, passing just ahead and north of Earth either late day 3 or early day 4 (11th or 12th). This from a filament eruption was observed from the northwest disc at 07/0730UTC.

Observed solar winds continue to be elevated as Earth moves into the fast wind of coronal hole 29/+. This is a small, non-persistent feature, and only shows as a very weak enhancement in enlil on the 9th. Given current solar wind conditions, a clear transition into this fast wind is unlikely, and potentially has already occurred. Solar winds are then expected to gradually ease towards background by day 3 or 4 (11th and 12th).

Geomagnetic activity is forecast to be Quiet to Unsettled. Active intervals possible day 1 and perhaps day 2 (9th and 10th), with a slight chance of G1-Minor Storms day 1 (9th). Very slight chance of Active to G1 Minor Storm if a more impactful arrival of the CME occurs later day 3 or early day 4 (11th or 12th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	1	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Enlil showing close encounter with CME passing north and ahead of Earth.



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Radio Blackouts - X-Ray Flares:

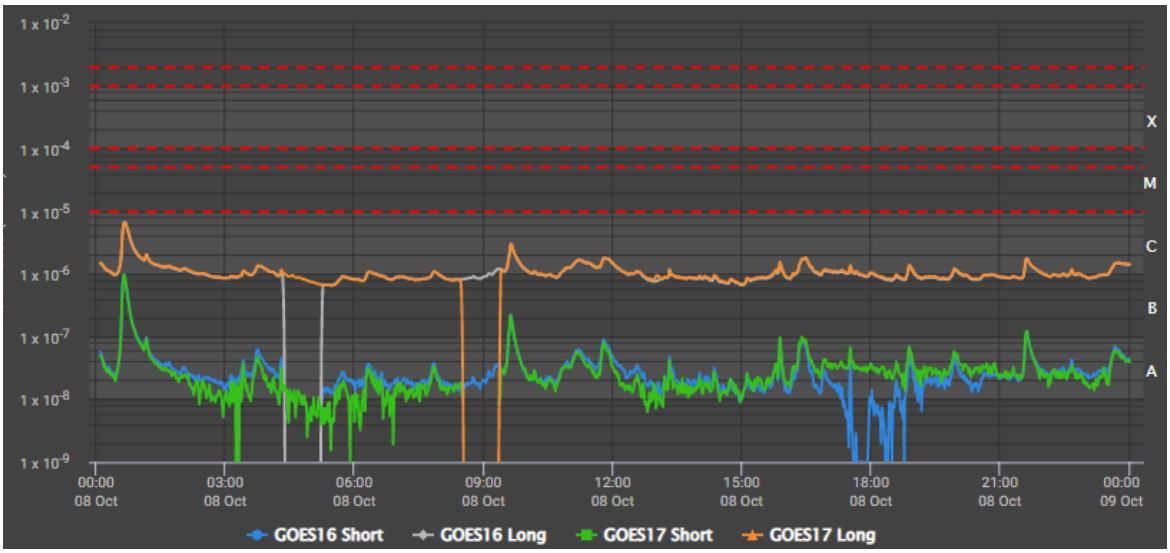
Solar Activity is currently Low, with recent activity limited to small C-class flares. Activity is expected to persist at this level, but with a chance of rising to Moderate from any isolated M-flares, with a slight chance of X-flares.

There are six sunspot regions on the disc. AR3112 Fki/Beta-Gamma-Delta is the largest, and most complex region, but has persisted as a stable area. Some penumbral areal extent reduction was evident across its leader, however a weak delta configuration is maintained despite some separation between the opposite polarity umbrae. Furthermore, consolidation was evident amongst intermediate spots near the trailer suggesting some weak ongoing developments. It is too early to tell if this has the potential to provide some instability to the region.

AR3116 Esi/Beta to the north of AR3112 is a smaller and relatively stable region, but was the source of the most recent M-flare, on the 7th. This has also seen some consolidation of intermediate spots, however a reverse polarity small spot emerging to the south of its leader perhaps suggests some potential instability. AR3119 Dai/Beta has been the source of the greatest growth during the last 24 hours, but remains a relatively simple, and small region. The other regions are generally decaying.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: GOES-16/17 X-Ray Flux



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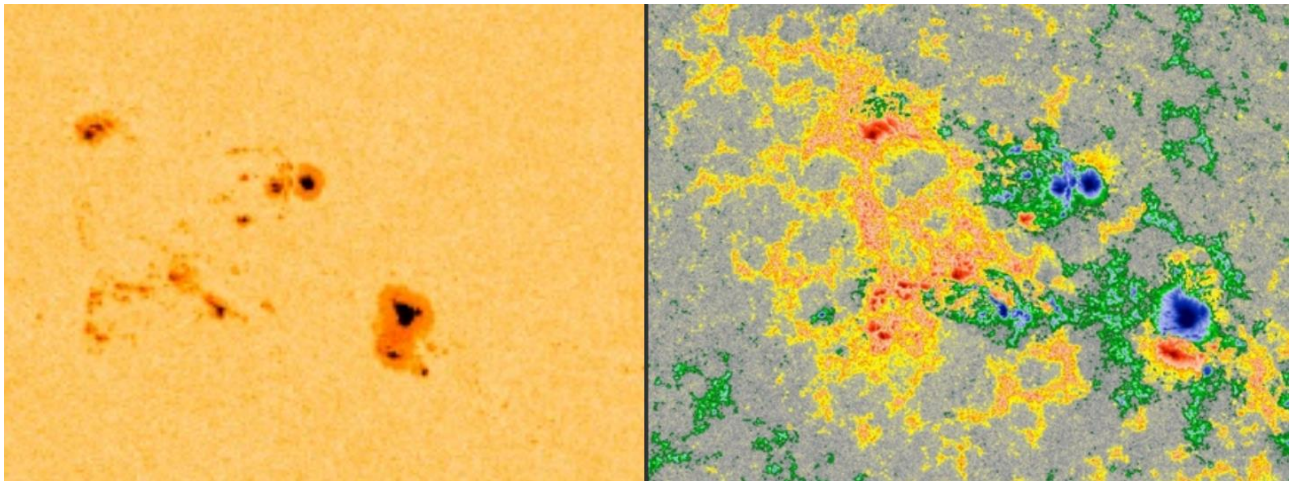
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) as observed by GOES16 is currently at Background levels.

AR3112 remains a complex, but stable region now moving into the northwest quadrant, however if it does flare this has the potential to produce high M or low X-flares. Alongside AR3116 to the north of this region, also now in the northwest quadrant, this brings a slight chance of flux levels rising should any flares occur. This gives a very slight chance of exceeding the S1 Minor Radiation storm level.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO Intensitygram (left) and Magnetogram (right) of AR3116 (top) and AR3112 (bottom)



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High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2MeV) electron flux as observed by GOES16 has persisted at Moderate to High levels in the last 24 hours. A potential suppression is possible day 1 (9th) alongside any geomagnetic activity that occurs the transition into the fast wind arrival of CH29, but likely recovering later day 1 or day 2 (9th or 10th) if this occurs. Otherwise further periods of High are likely each day.

The associated 24-hour electron fluence is likely to persist at Active levels for much of the period despite any potential suppression of flux day 1 (9th), albeit with decreasing confidence. REFM is currently giving poor guidance after T+24, and should be disregarded beyond this period.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	70	60	50
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: GOES 16 >2MeV Electron Flux and Fluence with REFM

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